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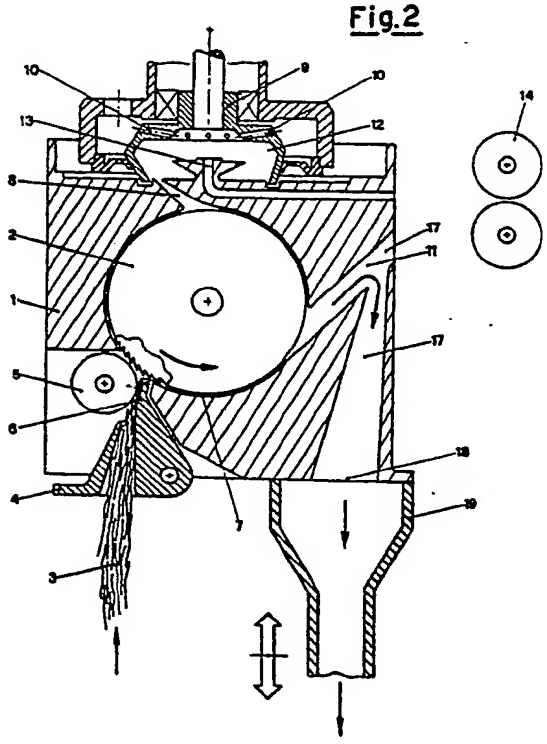
(54) Method and device for rejoining yarn with high efficiency in an open-end spinning machine.

(57) A method for rejoining yarn in an open-end spinning machine in which the rejoining is effected by feeding intact fibres to the rotor (12) but preceding the rejoining by an operation in which the sliver (3) is cleared and the carder (2) is cleaned by the high-vacuum suction nozzle (19) brought into correspondence with the air intake port (18).

Fig.2



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METHOD AND DEVICE FOR REJOINING YARN WITH HIGH EFFICIENCY IN AN OPEN-END SPINNING MACHINE

This invention relates to a method of yarn rejoining in open-end spinning machines, and more particularly to a method of preparing the fibre sliver which forms the feed before joining or rejoining the yarn to enable spinning to restart.

The open-end spinning process consists essentially of the following stages:

- feeding the fibre sliver to the spinning station by a feed roller;
- separating the sliver by a toothed carder which rotates at high speed and separates the sliver into individual fibres;
- pneumatically feeding the individual fibres to the hollow spinning rotor which is provided with an inner groove within which the fibres are deposited in layers by the effect of the centrifugal force generated by the rotor rotating at very high speed;
- an already formed yarn is initially inserted through the a channel located substantially on the axis of rotation of the rotor, centrifugal force propelling its free end to the periphery, ie into the groove where it encounters the fibre layer; on drawing out the yarn the fibres become joined to the yarn, acquiring twist in the section between the groove and the exit channel to produce new yarn.

In the known art the spinning machine is provided with yarn-feeling sensors which for every yarn breakage cause the fibre sliver feed roller to stop, as for example in Italian patent No. 791,993 of VUB.

However the separating carder continues to rotate even if yarn production is interrupted.

In the known art the method used for rejoining the yarn and restarting production comprises firstly cleaning the spinning rotor, in which irregularities or dirt build-up have probably occurred.

This cleaning is done either by opening the roller, clamping it and then using suitable tools such as brushes, suction nozzles, spatulas etc., or by keeping the roller closed and using an air blast.

After cleaning, a fibre layer suitable for forming new yarn is rebuilt in the spinning rotor while under movement, and the interrupted yarn end is reinserted when the rotor has reached suitable speed, to "fish out" this fibre layer and again produce yarn.

This operation is conducted either manually, in non-automated spinning machines, or automatically by devices located for example on mobile carriages which patrol the plurality of spinning stations along the machine face in the case of automated machines, as described in USA patents 3,810,352 and 3,950,926.

A technical problem common to both automated and non-automated spinning machines is that the fibre feed sliver which has been halted on yarn breakage, with its feed roller at rest, remains with its end exposed to the action of the separating carder. Generally, the rejoining operation is commenced with variable delay because the rejoining operation requires in the case of non-automated spinning machines the operator, or in the case of automated spinning machines the carriage, to arrive in front of the spinning station at which the operation is to be carried out. The operator or carriage can be a variable distance away, or may be engaged in other operations.

During this variable waiting time the end of the feed sliver continues to undergo separation, without advancing, and is depleted of fibres, which are gradually removed by the carder teeth.

When the sliver is reused in that state for restarting the spinning, the fibre layer newly deposited in the rotor groove and used for rejoining purposes gives rise to thinner or fatter weakened portions and thus an irregular joint, with the result that the produced yarn is of poor quality.

The sliver depletion varies in accordance with the waiting time for commencing the operation, and the layer initially deposited in the rotor groove consequently varies.

According to the known art this variability in the consistency of the fibre sliver re-fed to spinning is overcome by means of a brief prefeed of sliver during the initial stage of the rejoining operation.

This prefeed enables the state of the sliver to be equalized by consuming that portion of sliver which in the meantime has remained exposed to the action of the carder, so restoring the state of the sliver as if the yarn breakage had taken place at the moment the rejoining operation commences.

This prefeed operation to equalize the state of the sliver end which is to be used for rejoining the yarn must necessarily be effected after the arrival of the operator or mobile carriage but before the rotor cleaning operation. The fibres removed from the deteriorated sliver during the waiting time for the operation are deposited in the rotor groove and are removed from there by the subsequent cleaning, whereas if the preliminary feed were to be effected after the rotor cleaning, this latter would not accomplish its purpose because uncontrolled depositing of other fibres would take place in the cleaned rotor.

Again, if the prefeed were to be effected with the rotor open it would give rise to unacceptable soiling.

The practice of prefeed goes back to the first open-end spinning machines and was already de-

scribed in the book Open-End Spinning by Rohlena et al., 1974, pages 323 onwards, as a preliminary stage.

According to Italian patent No. 1,045,600 in the name of Stahlecker, this prefeed is effected during the braking of the spinning rotor.

In this patent the sliver feed roller is operated for prefeed purposes by an auxiliary motor positioned on the mobile carriage because during the rejoining operation this feed roller is disconnected from its normal drive, which is used only during spinning.

The practice of pre-feeding the sliver, whether effected as the preliminary stage of the rejoining cycle or during rotor braking, satisfies its purpose of equalizing the state of the sliver re-fed to enable spinning to resume by the rejoining operation, but does not completely solve the problem of its deterioration.

In this respect it must be remembered that after the equalization to procide a constant sliver not influenced by the variable waiting time for the commencement of the rejoining operation, the sliver remains at rest and exposed to the action of the carder, which continues to rotate, for the time period between the sliver prefeed and the return to normal feeding to deposit the new fibre layer for rejoining purposes.

The duration of this time interval is rigorously constant in the case of automated spinning machines in which the rejoining operation is robotized and generally carried out by a mobile carriage, and substantially constant where the operation is carried out by an operator who has acquired sufficient manual ability.

During this constant time interval the sliver is subjected to deterioration by the carder. This deterioration is a drawback which is not very important from the point of view of the quantity of residual fibres present in the sliver end because this can be remedied by controlling the time interval between the restoration of sliver feed and the "fishing out" of the fibre layer in the rotor cavity by the yarn end.

This drawback cannot however be totally overlooked from the point of view of the quality of the residual fibres present in the sliver end.

It must be remembered that the duration of the interval between prefeed and restoration of spinning in current automated open-end spinning machines is of the order of 10 seconds, and the carder has therefore a considerable time available for this deterioration action on the end of the halted sliver.

In this respect it has been found that one of the most important causes of defective joining, even using the prefeed practice, is that the sliver end, which remains subjected to the action of the carder for the entire duration of the said interval, is also subjected to qualitative deterioration because the sliver fibres are not only removed but also shortened, so that the new fibre layer deposited in the rotor cavity on restoring the sliver feed and which is used for the actual rejoining is formed from fibres of inferior quality as it also comprises a considerable amount of fibres shortened by the action of the carder rotating on the sliver which is at rest during the waiting time for the rejoining. This drawback is particularly marked if fine yarns of high metric count are produced, for which the prefeed practice does not allow a reliable joint of good quality. The joining operation must be frequently repeated because the joint is either not made or breaks.

In Italian patents Nos. 1,169,043 and 1,178,550 of V.U.B. it is proposed to firstly deviate during the rejoining operation those fibres of the damage portion of the sliver exposed to the action of the carder during the waiting period by not allowing them to reach the spinning rotor, so allowing the spinning rotor to receive only the undamaged fibres of the sliver portion which was not under the action of the separating carder while at rest. According to Italian patent No. 1,169,043 this deviation is done by suction channels which open into the pneumatic conveying path which the fibres separated by the carder take in travelling to the rotor, and by blowing nozzles which act against the normal movement of the fibres towards the rotor.

This device results in considerable complications both in the spinning device and in its operation.

In the subsequent Italian patent No. 1,178,550 the deviation is done by using the aperture in the duct tangential to the carder to remove the impurities. The impurities, such as dust, sand and dirt, are more subject to the action of centrifugal force as they are heavier and more compact than the separated fibres.

The impurities are thus projected outwards through this tangential duct which connects to a suction manifold in which a slight vacuum is maintained sufficient to induce an air stream powerful enough to convey the impurities but not to suck the fibres from the carder.

This vacuum is by way of example a few tens of mm. of water column or a few mm. of mercury expressed as static vacuum.

The various suction manifolds converge into a large central duct under vacuum which collects all impurities and conveys them to a collection box and distributes the suction to the various spinning units. According to patent No. 1,178,550 a tubular suction nozzle is inserted into the suction manifold until is mouth engages the aperture of the tangential duct to shut off the suction manifold, and after it

has been inserted in position the suction is applied to the damaged fibres.

This method is not free of drawbacks because the suction nozzle carried by the service carriage must be carefully constructed and positioned with great accuracy relative to the spinning station, and in addition travels a long distance in positioning itself and withdrawing, so extending the duration of the rejoining cycle. In addition there is disturbance to the initial spinning conditions, both due to the lack of suction for the impurities precisely during and immediately after the rejoining operation when the suction nozzle withdraws to its rest position to again engage the frontal air intake port, and due to the consequent pressure pulsations which arise when the air intake port is released. The present invention provides a device and improved method of rejoining yarn in an open-end spinning machines which enables the rotor to be supplied with totally intact and impurity-free fibres for the rejoining operation.

The device and method are described with reference to Figure 1 which shows a spinning unit during its normal operation, and Figure 2 which shows the spinning unit during the rejoining cycle. The spinning unit consists of a fixed support 1 in which the rotary carder 2 is positioned, provided along its outer cylindrical surface with saw-toothing to separate the fibres of the feed sliver.

The fibre sliver 3, originating from an underlying chamber not shown on the figure, is fed along a fixed guide 4 by the feed roller 5 which rotates in an anticlockwise direction in order to feed the sliver towards the carder 2. The feed roller 5 is preferably provided with knurling on its cylindrical surface to increase the dragging effect on the sliver, contact between the sliver 3 and roller 5 being ensured by an approach member 6 the surface of which is kept in proximity to, but not in contact with, the cylindrical surface of the roller 5 by a suitable pneumatic or elastic device not shown on the figure, so that the sliver 3 is guided into contact with the cylindrical surface of the roller 5. In the practical embodiment the approach member 6 is a sliding block 20 with a concave surface facing the roller 5.

In this manner the sliver 3 is fed to the carder 2, which separates it into individual fibres. The individual fibres travel through the interspace 7 surrounding the carder 2 and are conveyed pneumatically through the channel 8 to the cavity of the rotor 9, which rotates at very high speed.

A vacuum is generated within the cavity of the rotor 9 by the effect of its speed and the perforations 10, or by the action of a separated suction source, and sucks the fibres separated by the carder 2, withdrawing air both from the interspace 7 and through the aperture 11.

Inside the rotor 9 the fibres are subjected to high centrifugal force and are urged towards the periphery where they collect in the annular groove 12 to form a layer of suitable size. An already formed yarn is then inserted through the channel 13 at the commencement of spinning. Its free end is urged by centrifugal force to the periphery of the rotor where it encounters the fibre layer, the yarn then being withdrawn for example by a pair of rollers 14. The fibres join to the inserted yarn and acquire twist along the path between the annular groove and the axis of the rotor 9, where the exit channel 13 is located.

The produced yarn 15 is extracted and collected in packages or bobbins by a collection system, not shown on the figure. The impurities which escape the carder 2 are discharged by centrifugal force from the aperture 11, which connects the tangential duct 16 to the suction manifold 17.

Conveying air is drawn into the manifold 17 through the air intake port 18 by the effect of the vacuum downstream of the manifold 17, indicatively about 50 mm of water, in the direction of the light arrows.

When a breakage occurs in the yarn 15, a sensor not shown on the figure causes the feed roller 5 to stop and halts collection of the yarn 15 in known manner.

The yan-feeling sensor also calls the service carriage to the spinning station in which yarn breakage has taken place, to effect the yarn rejoining operations in accordance with the cycle described heretofore.

During the intervention cycle the roller 5 remains at rest and the end of the sliver 3 is progressively depleted and degraded by the carder 2, which continues to rotate.

At the same time the rotor 9 is halted to enable its groove 10 to be cleaned. Thus the pneumatic conveying action in the duct 12 which sucks the fibres from the duct 8 to the rotor 9 ceases, and the fibres removed from the sliver by the rotary carder at least partly remain on the carder and in the interspace 7.

According to the present invention, for the yarn rejoining operation a high-vacuum suction nozzle 19 carried on the service carriage is brought into correspondence with the air intake port 18 and is able to approach and withdraw from the spinning unit in accordance with the double-direction light arrows.

When the rotor has been cleaned and before returning it to the speed at which the new fibre layer is to be deposited for the actual rejoining operation, an energetic suction action in the direction of the dark arrows is initiated by a solenoid valve, not shown on the figure but connected into the duct containing the nozzle 19, under a vacuum

much higher than that maintained in 17 during normal operation. The levels of static vacuum which enable a good joint to be made are indicatively between 300 and 900 mm of water and preferably between 450 mm and 700 mm.

This energetic suction allows removal from the carder 2 and interspace 7 of all the fibres deposited there during the stages preceding the intervention cycle, ie those in which the sliver was deteriorated by the action of the carder 2.

Immediately afterwards, the sliver 3 is again fed by the roller 5 to the carder 2 while maintaining the interspace 7 under energetic suction, and the rotor is restarted.

The deteriorated fibres present at the end of the sliver are thus combed away by the carder 2, and drawn towards the aperture 11 and nozzle 19. After the deteriorated portion has been removed, the suction action of the nozzle 19 is shut off and this latter can be removed, to restore normal vacuum in 17.

The fibres separated by the carder 2 again flow to the rotor 9, which in the meantime has reached the required speed for depositing the new layer of fibres and has restored its pneumatic sucking action through the duct 8.

The fibres thus fed to the rotor 9 are perfectly intact and allow a better quality of joint.

As can be seen, the nozzle 19 does not have to travel long distances or be accurately positioned. Sealing is ensured by a soft annular gasket.

The time required for cleaning the carder 2 and interspace 7 and for removing the damage fibres from the sliver is very short, with an indicative total of less than 7 seconds.

Using the method of the invention, high-efficiency joints have been obtained even on fine yarns, with a metric count of 40-80, to the extent of more than 95% as shown by subjecting them to joint tests; In the case of medium yarns, this efficiency reached 99%.

Claims

1. A method of rejoining yarn in an open-end spinning machine which comprises a spinning rotor 9, and a separating carder 2 fed with the fibre sliver 3 by a feed roller 5 to produce individual fibres which are fed to the spinning rotor by pneumatic conveying, said carder being housed in a cavity provided with an aperture 11 for removing impurities, in which the rejoining is effected by returning the yarn end into contact with the layer of fibres newly deposited in the groove 12 of the rotor 9 after its cleaning, characterised in that before depositing the new layer of fibres in the groove 12 of the rotor 9, both the fibres still contained in the cavity which encloses the carder 2 and the deteriorated fibres at the end of the sliver 3 which have been moved forward by the feed roller 5 are removed by the effect of a high-vacuum suction nozzle 19, said fibres being evacuated through the aperture 11; the new fibre layer, consisting of intact fibres, being deposited when the high-vacuum suction action ceases.

2. A method of rejoining yarn in an open-end spinning machine as claimed in claim 1, characterised in that the suction action is commenced before returning the cleaned rotor to the speed at which fibre deposition is to restart and before the sliver 3 is again fed by the roller 5, and is maintained until the rotor 9 has reached the speed required for depositing the new layer of fibres.

3. A method of rejoining yarn in an open-end spinning machine as claimed in one or more of the preceding claims, characterised in that the suction action is conducted with a static vacuum of between 300 and 900 millimetres of water column.

4. A method of rejoining yarn in an open-end spinning machine as claimed in one or more of the preceding claims, characterised in that the suction action is conducted for a short time period of up to 7 seconds.

5. A device for rejoining yarn in an open-end spinning machine by the method claimed in one or more of the preceding claims, characterised in that the suction nozzle 19 is carried by the service carriage of the spinning machine and undergoes approach and withdrawal movement to face the air intake port 18 of the suction manifold 17.

6. A device for rejoining yarn in an open-end spinning machine as claimed in claim 5, characterised in that the suction nozzle 19 is provided with a solenoid valve which precisely determines the times at which the suction action begins and finishes.

Fig.1

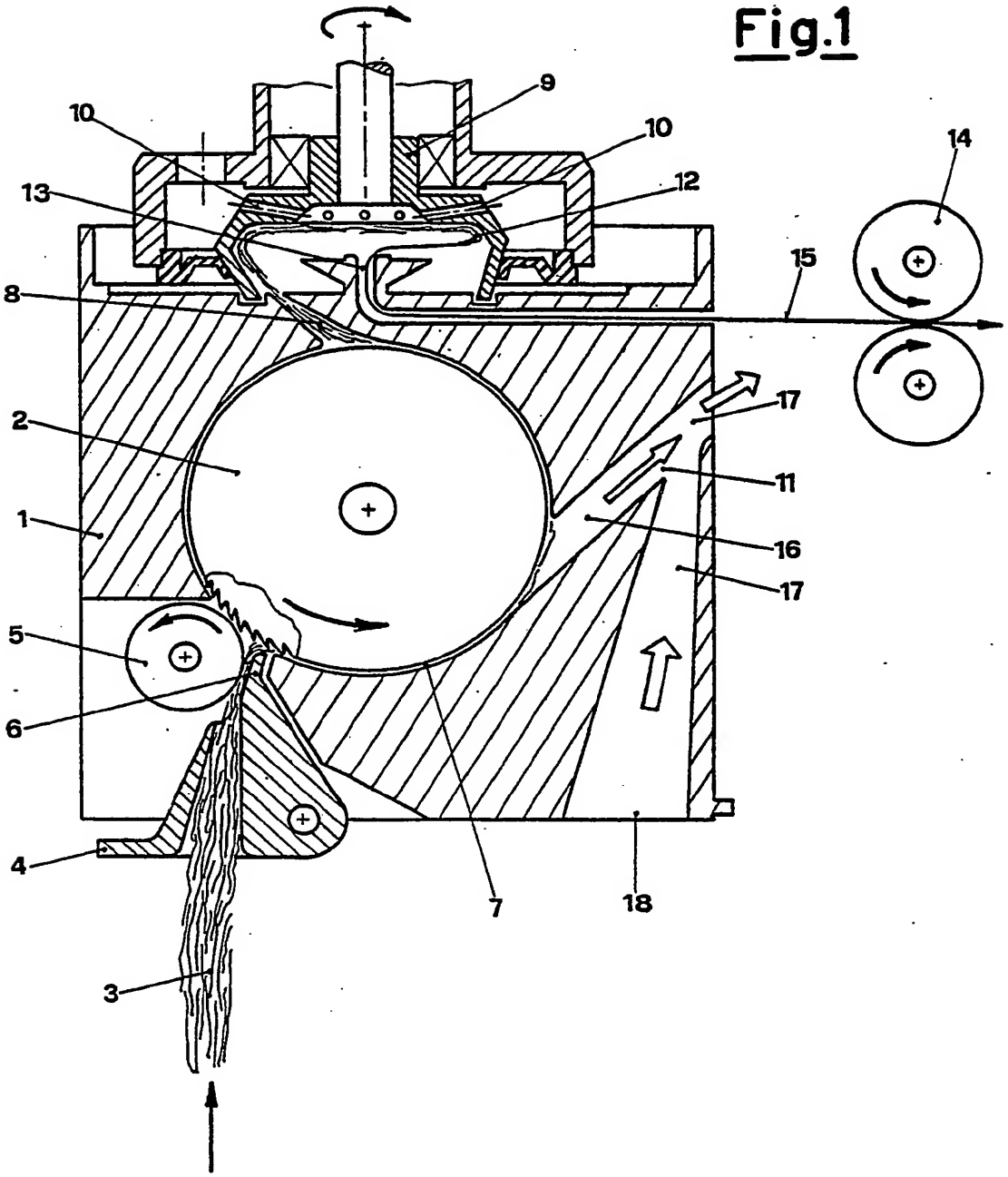
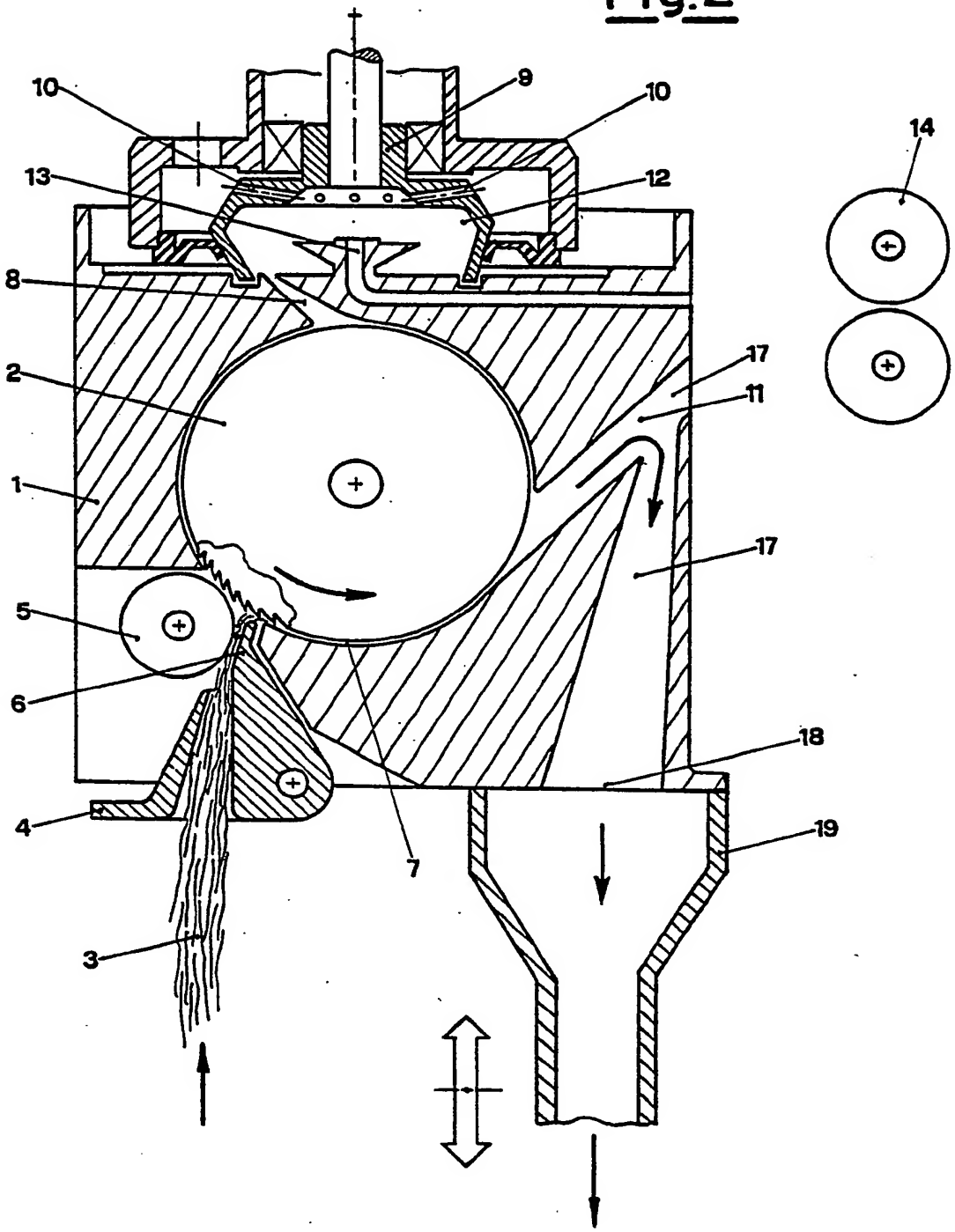


Fig.2



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EUROPEAN SEARCH REPORT

Application Number

EP 89 20 2411

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8601235 (SCHUBERT & SALZER MASCHINENFABRIK AG) * claims 1, 14 *	1, 5	D01H4/50
X	DE-A-3436295 (VYZKUMNY USTAV BAVLNARSKY) * page 7, line 27 - page 8, line 5; figures 1, 2 * * page 8, line 16 - page 10, line 2 *	1, 5	
A	FR-A-2260644 (HIRAI HIRONORI) * page 1, lines 14 - 31; figure 4 * * page 4, line 28 - page 5, line 6 * * page 5, line 13 - page 6, line 6 *	1, 5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
D01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 MARCH 1990	HOEFER W.D.

CATEGORY OF CITED DOCUMENTS

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